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TWO NEW SPECIES OF *NESTICUS* SPIDERS FROM THE SOUTHERN APPALACHIANS (ARANEAE, NESTICIDAE)

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ABSTRACT. Diagnoses, descriptions, illustrations, and natural history data are presented for two new species of *Nesticus* spiders: *N. nasicus* from epigean habitats in southwestern North Carolina, and *N. gertschi* from a cave in eastern Tennessee. *Nesticus nasicus* appears to be the sister species of *Nesticus brimleyi* Gertsch, a cave-dwelling species.

In his pioneering revision of North and Central American nesticids, Gertsch (1984) predicted that, as greater attention was focused on these secretive cave- and litter-dwelling spiders, many new species would be added to the already large, apparently monophyletic, clade of 24 southern Appalachian species of *Nesticus*. We describe here a new epigean species, *Nesticus nasicus*, and a new cave-dwelling species, *Nesticus gertschi*, both of which, like the majority of the known southern Appalachian species, have restricted ranges, are allopatric, and live in eastern Tennessee and/or western North Carolina (Map 1).

RELATIONSHIPS

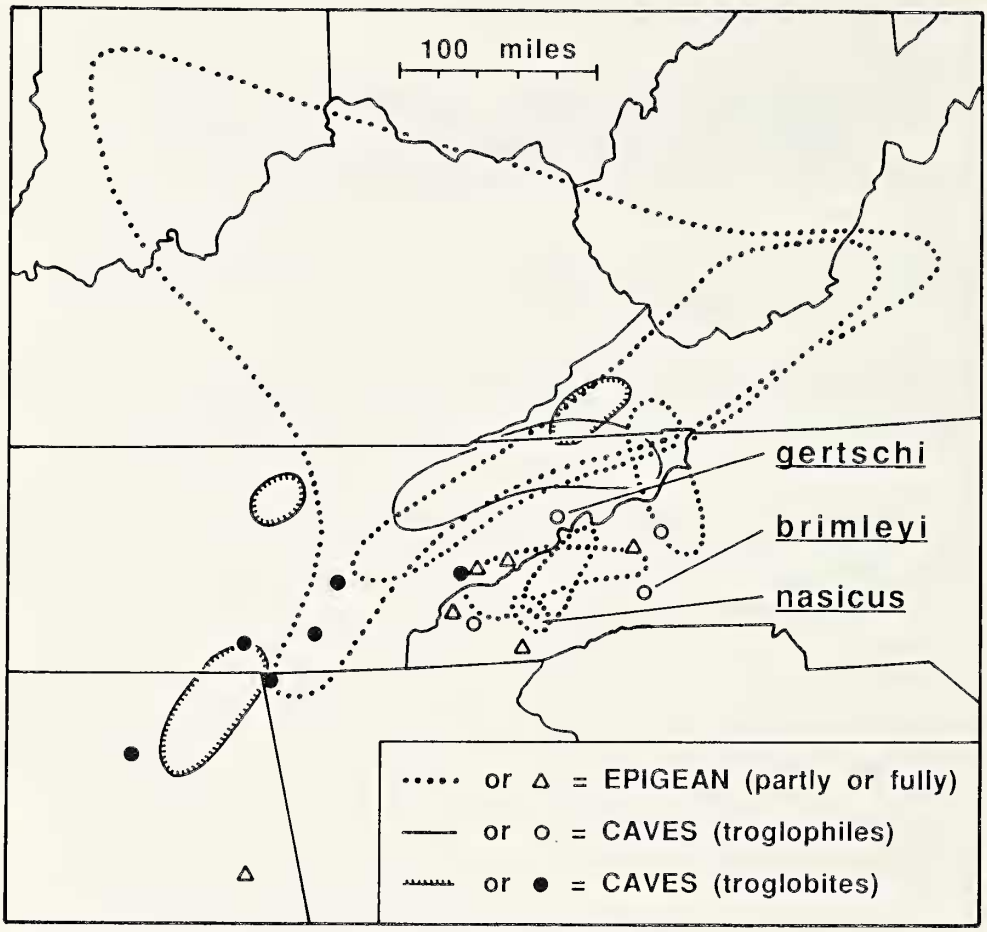
Since Gertsch (1984) did not present a cladistic analysis of relationships of *Nesticus* species and since we have examined specimens of only two of the 41 described species (and have therefore relied heavily on Gertseh's drawings and descriptions), our hypotheses of relationship are especially tentative.

The numerous similarities between *Nesticus nasicus* and *Nesticus brimleyi* Gertsch strongly suggest that they are sister species. These similarities include the following putative synapomorphies: 1) the broad, thin and translucent, serrate distal process of the paracymbium [Figs. 1–6]; 2) the massive size of the paracymbium [Figs. 1, 6]; 3) a median palpal apophysis with two converging processes [Figs. 1, 6]; 4) a sharply tapering tegular process hidden under the median apophysis [Figs. 1, 6]; and 5) a thick-walled bulb-shaped spermatheca near each lateral border of the epigynum [Figs. 11, 14]. We postulate that the common ancestor of *N. nasicus* and *N. brimleyi* was, like several extant *Nesticus* species (Gertsch 1984), a troglophilic species consisting of both epigean and cave-dwelling populations, and that its range, restricted to a cave-poor region of the southern Blue Ridge Province, included the areas now occupied by *N. nasicus* and *N. brimleyi* (Map 1). We further suggest that the epigean populations disappeared from the slightly dryer (Clay et al. 1975) eastern portion of the range leaving the *N. brimleyi* lineage isolated in the humid refugium provided by the isolated cluster of fissure caves it now occupies.

The relationships of *N. gertschi* are much less clear. It shares with *N. nasicus* and *N. brimleyi* the broad, translucent, spatulate, distal paracymbial process which appears to be unique to these three species among all American *Nesticus* for which males are known (Figs. 1–6, 15–17). However, there is no similarly distinctive female genital character state shared by *N. gertschi* and these two species.

METHODS

The quantitative character values in Table 1 are an integral part of each description. These characters are abbreviated and defined as follows: BL—body length; CL—carapace length; CW—carapace width; CH—clypeus height (length along median longitudinal line from edge of carapace to line connecting lowest edges of the two ALE's, with clypeus horizontal); AMD, ALD, PMD, PLD—maximum diameters of eye pupils with each eye on horizontal plane; AMS—distance between AME and ALE (each eye interdistance is measured after positioning it on horizontal plane); AS—distance between AME and ALE; PMS—distance between PME's; PS—distance between PME and PLE; IFL, IPL, ITL,



Map 1.—Distribution of all known southern Appalachian *Nesticus* species, based upon locality and habitat records in Gertsch (1984). Each of the 16 species collected at only one or a cluster of neighboring localities is represented by a single symbol. Known range boundaries of the nine more widely distributed species are approximated by dotted or solid lines.

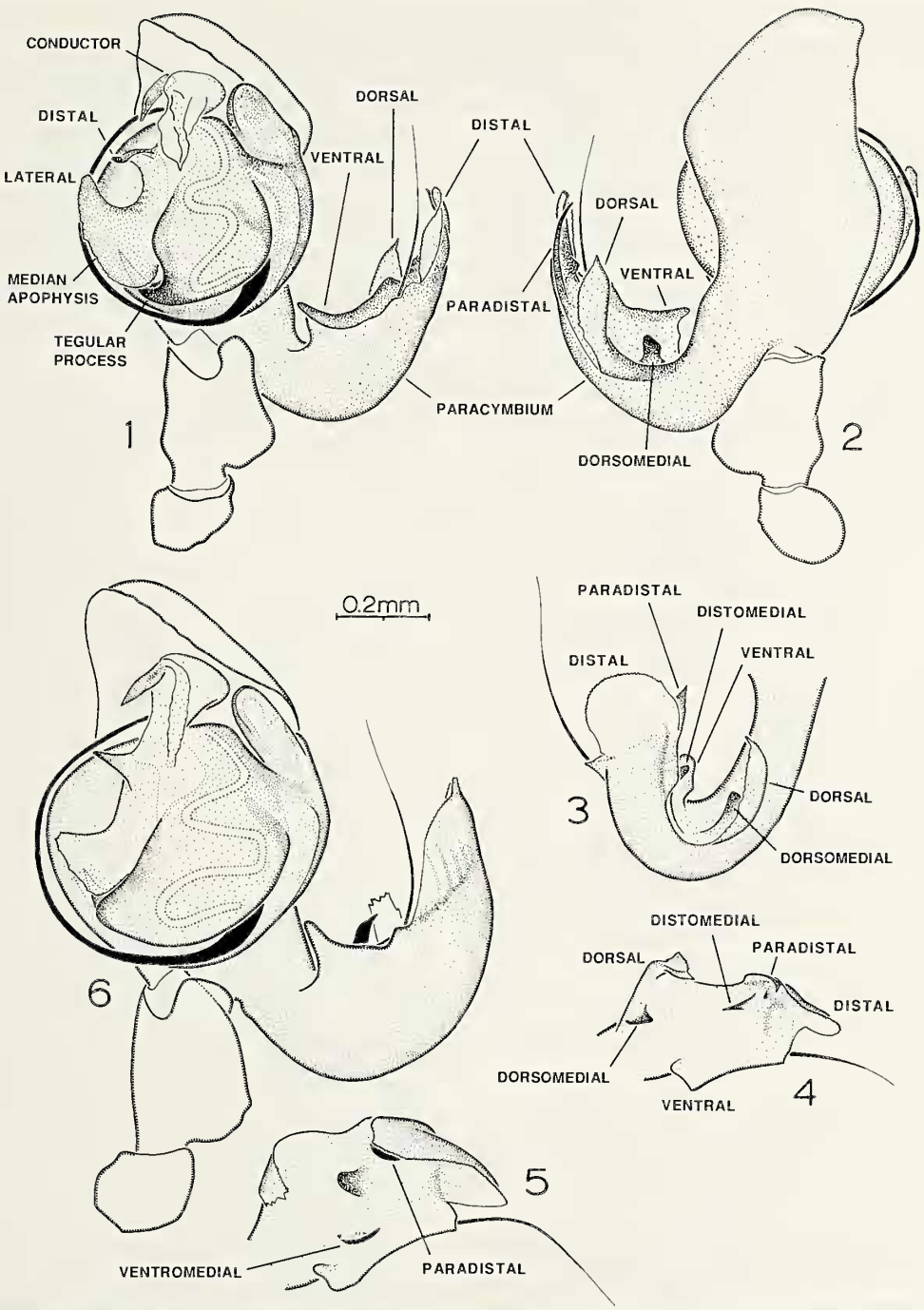
IML, ITarL—lengths of leg I articles (distance in retrolateral view from proximal condyle to most distal point on dorsal surface); EW—distance between lateral pockets of the epigynum (Fig. 12); MSE—length of the caudal extension of the median septum (Fig. 12) (epigynum measurements made with abdomen tilted so that ventral surface of epigynum is on horizontal plane). Eye diameters and appendage measurements were recorded from the left eye or appendage unless it was damaged, missing, or not fully regenerated (in which case the right structure was measured).

Measurements are in mm and were recorded with a Wild M-5 stereomicroscope with 20× ocular lenses and an eyepiece micrometer scale. BL, CL, CW, and leg measurements were performed at 50× and are accurate to 0.018 mm; all other measurements were performed at 100× and are accurate to 0.009 mm. Internal (dorsal) views of cleared (85% lactic acid) epigyna were drawn with a compound light microscope fitted with a drawing tube. We follow Gertsch's (1984) terminology for genital anatomy. All specimens are deposited in the American Museum of Natural History (AMNH).

Nesticus nasicus, new species
Figs. 1–4, 7–14. Map 1.

Types.—Male holotype and one male and three female paratypes collected under loose rocks 30 m outside west entrance of Cowee Mountain train tunnel (1900 ft elev.), 1 mi W Dillsboro, Jackson County, North Carolina (28 October [holotype, 2 females] and 11 November [other adult male] 1990 and 20 April 1991 [penultimate male, which escaped in captivity, and female]; A. McGarity), in AMNH.

Etymology.—The specific name, a Latin ad-



Figures 1–6.—Palpi of *Nesticus* holotypes, with paracymbial processes and some other structures labeled: 1–4, *N. nasicus*; 1, ventral; 2, dorsal; 3, retrolateral view of paracymbium; 4, medial (concave) surface of paracymbium; 5, 6, *N. brimleyi*; 5, medial (concave) surface of paracymbium; 6, ventral.

jective, refers to the nose-like appearance of the middle septum of the epigynum.

Diagnosis.—Males of *N. nasicus* are readily distinguished from those of all other American *Nesticus* species by the broad translucent distal paracymbial process accompanied by a sharp-tipped paradistal process (Fig. 3), and from all but *N. brimleyi* by the distinctively shaped me-

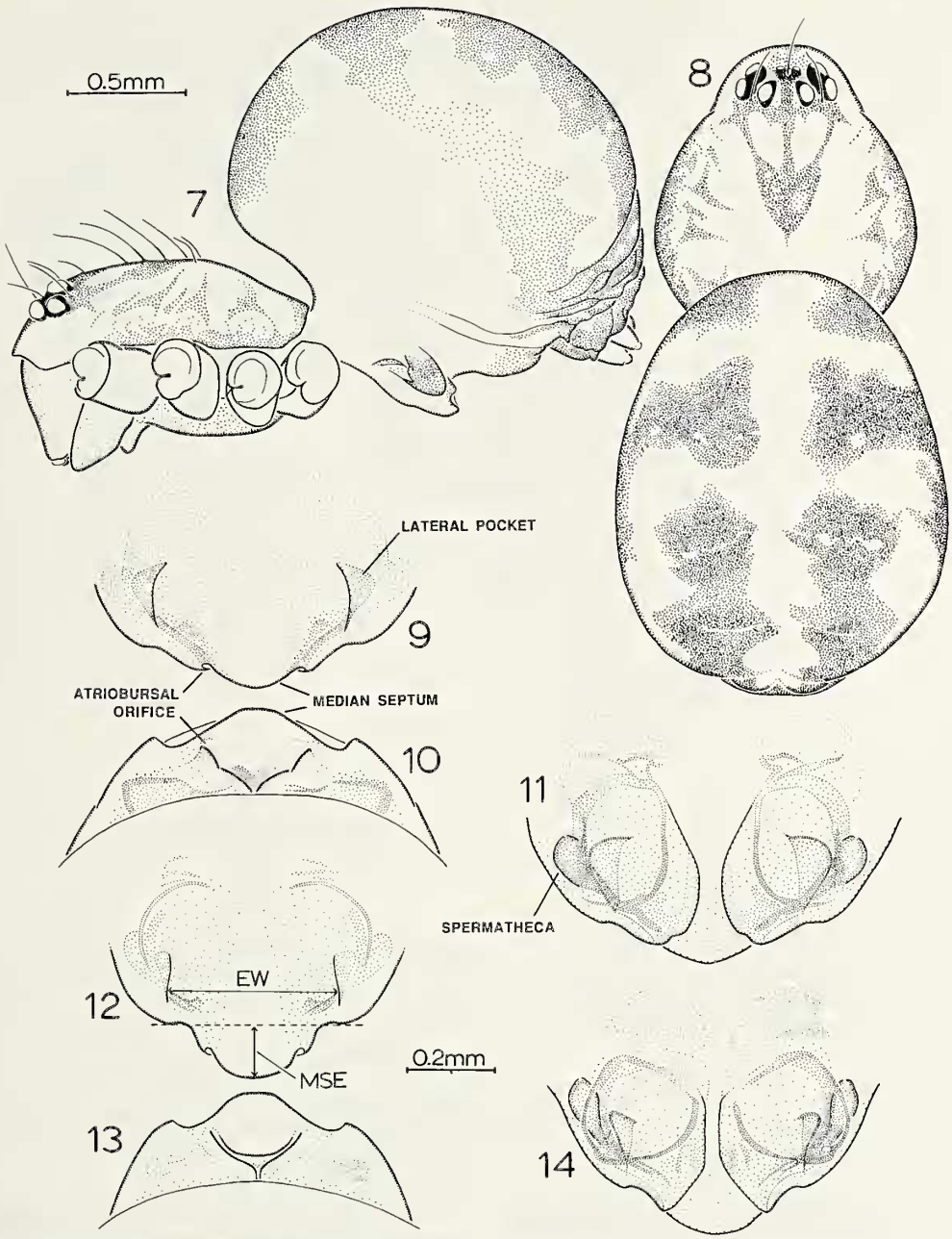
dian apophysis and tegular process (Fig. 1). The following features of the palp, particularly the position and shape of the paracymbial processes, distinguish *N. nasicus* males from those of its sister species, *N. brimleyi*: 1) ventromedial paracymbial process absent [Fig. 4] vs. present [Figs. 5, 6]; 2) dorsomedial paracymbial process present [Figs. 2-4] vs. absent [Fig. 5]; 3) paradistal paracymbial process narrow and pointed [Figs. 2-4] vs. broad and blunt [Fig. 5]; 4) dorsal paracymbial process tapers to a single point [Figs. 1-3] vs. truncate with three or more irregular points [Figs. 5, 6]; 5) distal paracymbial process rounded [Fig. 3] vs. angular; 6) base of tegular process evenly curved and gradually tapering [Fig. 1] vs. a lobe-like shoulder [Fig. 6]; 7) tegular process with one vs. two dorsal keels; 8) lateral projection of median apophysis relatively long and strongly curved [Fig. 1] vs. short and weakly curved [Fig. 6]; 9) middle loop of seminal tube broad at base and blunt [Fig. 1] vs. relatively narrow at base and long [Fig. 6]. Additionally, the legs of *N. nasicus* males are proportionately much shorter [Table 1, ITL(100)/CL] than those of *N. brimleyi*. Females of *N. nasicus* are most readily distinguished from those of other American *Nesticus* species by their unique, medially directed, epigynal pockets [Figs. 9, 11, 12, 14]. Although it was not possible for us to examine *N. brimleyi* females, Gertsch's (1984) figs. 138–140 and description reveal the following distinctive *N. nasicus* traits: 1) lateral epigynal pockets [Figs. 9, 11, 12, 14] not present on *N. brimleyi*; 2) much darker abdominal pigmentation [Figs. 7, 8] than *N. brimleyi*; and 3) legs proportionately much shorter [ITL(100)/CL = 142–161] than those of *N. brimleyi* [ITL(100)/CL = 214].

Males.—Table 1. Palpus [Figs. 1–4] with large paracymbium with broad, translucent, serrate distal process; sharp-tipped paradistal apophysis; thin dark distomedial process; prominent ventral process with distal edge turned outward; thin, sharp-tipped, leaf-like dorsal process, serrate and very thin on its ectal edge; and thin dark dorsomedial process on base of dorsal process. Tegular process tapers to sharp tip behind median apophysis, with dorsal keel visible in prolateral view. Median apophysis with large, roughly serrate, lateral process and prominent distal process with twisted tip. AME's with well-defined lenses. Color very similar to that of females except carapace less heavily pigmented.

Females.—Table 1. Epigynum [Figs. 9–14] with prominent median septum with rather broad rounded caudal projection; medially facing lateral pocket on each side; two avocado-shaped spermathecae (one ectal to each pocket) visible in cleared dorsal view; keel-like rim borders each atriobursal orifice, the two rims together forming a V-shaped pattern in posterior view. AME's [Fig. 8] with well-defined lenses. Color [Figs. 7, 8] of appendages chiefly pale tan but whiter or darker in places; carapace very pale tan with grey pigment as in Fig. 8; abdomen dorsally with segmental series of large paired lateral areas of grey on white background.

Variation.—Although there is no noteworthy variation within either population sample, the two populations differ in the following female characteristics, most of which are epigynum features. 1) The caudal lobe of the median septum of the Wolf Creek sample [$n = 4$] is absolutely [MSE = 0.111–0.129, mean = 0.123 ±0.009] and proportionately longer [MSE(100)/EW = 26.1–32.6, mean = 29.3 ±2.8] [Fig. 12] than that of the type sample [$n = 3$] [MSE = 0.056–0.093, mean = 0.074 ±0.018; MSE(100)/EW = 10.7–20.0, mean = 15.6 ±4.7] [Fig. 9]. In posterior view the dorsal contour of this lobe, enlarged as it is in the Wolf Creek specimens, presents a distinct transverse upcurved line [Fig. 13] not present in the paratypes [Fig. 10]. 2) Each of the two diagonal keels forming the V-shaped rim bordering the atriobursal orifices and visible in posterior view is entire in the Wolf Creek specimens [Fig. 13] and not interrupted as in two of the three paratypes [Fig. 10]. 3) The external lateral epigynal pockets tend to be smaller and directed more anteriorly in the Wolf Creek specimens [Figs. 12, 14] than in the paratypes [Figs. 9, 11]. 4) The first leg articles are proportionately longer in the Wolf Creek specimens [ITL(100)/CL = 152–161, mean = 158 ±4.2)] than in the paratypes [ITL(100)/CL = 142–147, mean = 146 ±2.7)].

These differences suggest that there may be little or no gene flow across the 11 miles separating these local populations. Determining whether this is the case and whether these populations are reproductively isolated requires the collection and study of males from Wolf Creek, a search for geographically intermediate populations, and, most importantly, cross-mating trials. The small allopatric geographic ranges characteristic of most of the southern Appalachian species (Map 1) suggest that low vagility is a common *Nesticus* trait.



Figures 7–14.—*N. nasicus* females: 7–11, paratypes; 7, lateral view of body; 8, dorsal view of body; 9–11, epigynum; 9, ventral; 10, posterior; 11, dorsal (cleared); 12–14, specimen from Wolf Creek; 12, ventral; 13, posterior; 14, dorsal (cleared). Scale lines: 0.5 mm for Figs. 7, 8; 0.2 mm for Figs. 9–14.

Natural history.—The Cowee Mountain specimens were living just outside the train tunnel on the undersides of rocks which had fallen from a high rock cut and accumulated in a wet leaf litter-filled depression between the base of the cut and the railway roadbed. The holotype male and two females were collected under the same large flat rock; the females were in small webs consisting of a sparse asymmetrical mesh of silk threads extending from the underside of this rock to smaller rocks beneath. The adult female collected on 20 April had just molted. The absence

Table 1.—Quantitative character values for *Nesticus* species. Characters are defined in methods section of text. All measurements in mm. Range, mean, and standard deviation given for large sample. * The second value for each character is from the holotype. ** Except for CH, the first value for each character is from the holotype; values for the second male are from Gertsch (1984), who erroneously indicated that the specimen he measured was the holotype.

	nasicus		*brimleyi*	*gertschi*	
	Males* ($n = 2$)	Females ($n = 7$)	Males** ($n = 2$)	Male	Female
BL	2.42, 2.66	2.41–3.07 (2.72 ± 0.26)	3.14, 4.00	3.48	3.42
CL	1.28, 1.43	1.18–1.33 (1.28 ± 0.05)	1.74, 2.00	1.61	1.31
CW	1.11, 1.24	1.04–1.15 (1.11 ± 0.04)	1.52, 1.75	1.37	1.48
CH	0.231, 0.259	0.176–0.231 (0.201 ± 0.017)	0.350, 0.361	0.296	0.250
AMD	0.028, 0.037	0.028–0.037 (0.032 ± 0.005)	0.037	0.037	0.037
ALD	0.102, 0.102	0.074–0.093 (0.087 ± 0.007)	0.111	0.083	0.093
PMD	0.093, 0.093	0.093–0.102 (0.095 ± 0.005)	0.093	0.083	0.083
PLD	0.093, 0.093	0.083–0.102 (0.094 ± 0.006)	0.093	0.093	0.102
AMS	0.037, 0.065	0.037–0.056 (0.049 ± 0.007)	0.083	0.037	0.046
AS	0.046, 0.056	0.046–0.056 (0.049 ± 0.005)	0.074	0.074	0.065
PMS	0.093, 0.102	0.083–0.111 (0.096 ± 0.009)	0.139	0.129	0.129
PS	0.056, 0.065	0.046–0.074 (0.057 ± 0.010)	0.083	0.083	0.074
IFL	2.07, 2.44	1.89–2.20 (2.07 ± 0.12)	3.92, 4.80	3.63	2.89
IPL	0.56, 0.65	0.52–0.59 (0.57 ± 0.03)	0.80, 1.00	0.72	0.65
ITL	2.04, 2.44	1.74–2.09 (1.95 ± 0.12)	4.14, 5.15	3.74	2.79
IML	1.87, 2.18	1.55–1.85 (1.72 ± 0.10)	3.85, 4.50	3.37	2.48
ITarL	0.89, 1.04	0.83–0.93 (0.88 ± 0.03)	1.48, 1.50	1.35	1.15
EW		0.40–0.52 (0.45 ± 0.04)			
MSE		0.056–0.129 (0.102 ± 0.029)			
MSE(100)/EW		10.7–32.6 (23.4 ± 8.1)			
ITL(100)/CL	159, 171	142–161 (153 ± 8)	238, 258	232	213
AMD(100)/CH	12.0, 14.3	13.0–19.0 (15.8 ± 2.4)	10.3	12.5	14.8
AMD(100)/CW	2.5, 3.0	2.4–3.3 (2.8 ± 0.4)	2.4	2.7	2.5

of *Nesticus* within the dark but dry train tunnel and on the surface of the moist north-facing rock cut above the inhabited rock pile indicates that *N. nasicus* requires both very high humidity and very low light intensity.

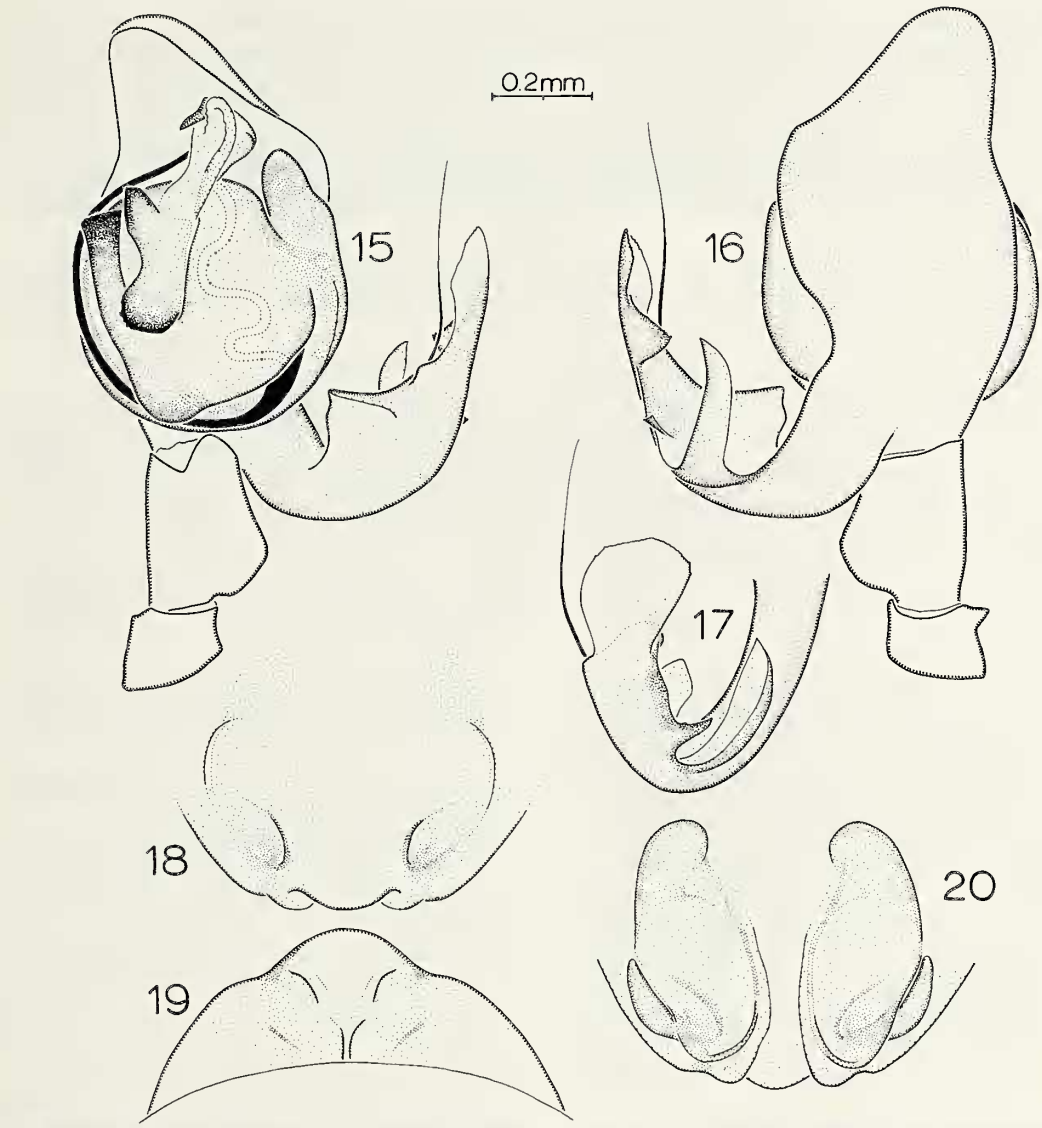
The other *N. nasicus* population sample was collected in the leaf litter of a mesic deciduous forest on steep rocky north- and south-facing slopes on each side of Wolf Creek. Tullgren funnel extraction of this leaf litter collected on 14 and 16 November yielded two adult females, four antepenultimate or penultimate females, two penultimate males, two antepenultimate males, and three younger juveniles (CW = 2.68–4.16 mm). These data and the presence of adult females at the type locality during both fall and spring indicate that *N. nasicus* adults may occur during most or all of the year, as is true for at least some of the other species of *Nesticus* (Gertsch 1984), and that mating and egg-laying may therefore occur during several months of each year. Extended reproductive activity, an extreme case being the year-round egg-laying exhibited by cave populations of the nesticid *Eidmanella pallida* (Ives 1935) and many other cave animals (Howarth 1983), may constitute a primitive *Nesticus* cave-related trait which is expressed even in epigean species like *N. nasicus*.

Distribution.—Known from two localities 11 miles apart in the mountains of southwestern North Carolina (Map 1).

Other material examined.—NORTH CAROLINA: *Jackson Co.*, Wolf Creek, 5 mi S Cullowhee, 2400 ft elev., deciduous forest leaf litter, 13 September 1990 (A. McGarity), 1 female; 24 October 1990 (A. McGarity), 1 female, 1 juv.; 14 November 1990 (F. Coyle), 1 female, 10 juvs.; 16 November 1990 (R. Dellinger), 1 female, 1 juv.; 24 February 1991 (F. Coyle), 2 juvs.

Nesticus gertschi, new species
Figs. 15–20. Map 1.

Types.—Male holotype and one female paratype collected 100 m inside Cedar Creek Cave (1400 ft elev.), Cedar Creek, Greene County,



Figures 15–20.—*N. gertschi*: 15–17, holotype palpus; 15, ventral; 16, dorsal; 17, retrolateral view of paracymbium; 18–20, paratype epigynum; 18, ventral; 19, posterior; 20, dorsal (cleared).

Tennessee (16 March 1991; A. McGarity), in AMNH.

Etymology.—The specific name is a patronym in honor of Dr. Willis J. Gertsch, the first revisor of American nesticids.

Diagnosis.—Among known species of Appalachian *Nesticus*, *N. gertschi* is one of only three species (including *N. brimleyi* and *N. nasicus*) with a broad, thin, translucent, serrate, distal paracymbial process (Fig. 17) and is the only one with a single, very long, flat, broad tegular process (Fig. 15). The collective shapes and positions of other paracymbial processes also distinguish this species (Figs. 15–17). The combination of the curved, ectally-facing, external epigynal grooves on each side of the median septum (Fig. 18), the large, sclerotized, internal anterior lobes (Figs. 18, 20), and the elongate, nearly banana-shaped spermathecae (Fig. 20) distinguish *N. gertschi* females from those of all other Appalachian *Nesticus* species.

Male.—Table 1. Palpus (Figs. 15–17) with large paracymbium with broad, translucent, slightly serrate distal process, two subdistal processes on dorsal edge, a thin, sharp-tipped, leaf-like dorsal process, and a prominent ventral process with

distal edge turned outward; tegular process long, broad, and thin with distomedial angle expanded toward distal lobe of median apophysis; median apophysis with broad, spatulate, roughly serrate lateral process and broad, angular, spatulate distal process. AME's with well-defined lenses. Color as in female except appendages darker tan than those of female.

Female.—Table 1. Epigynum (Figs. 18–20) with rather prominent broad median septum with little, if any, caudal extension; depression on each side of median septum with prominent, curved ectally-facing groove with sclerotized rim and more anteriorly and laterally a less conspicuous, curved medially-facing rim; two elongate spermathecae almost banana-shaped; two large, internal well-sclerotized lobes extending forward at anterior of epigynum; shallow keel-like rim borders each atriobursal orifice, the two rims converging dorsally in posterior view. AME's with well-defined lenses. Color of appendages very pale tan; carapace white to very pale tan with scattered areas of faint grey pigment on pars cephalica and around lateral border of pars thoracica, except dark amber to black around each eye; abdomen dorsally with segmental series of very small, faint, paired, lateral areas of grey on lighter pale beige-grey background.

Natural History.—The two specimens were collected in separate small concavites (19, 15 cm high; 15, 16 cm wide; 10, 6 cm deep) in the cave wall approximately 100 m from the entrance in the moist dark zone of the cave. Each spider was suspended back-downward from (or close to) the ceiling of its concavity and in the upper denser part of its web, a loose irregular mesh of threads confined to the upper portion of the concavity. When collected (16 March), both specimens were in the penultimate instar. They were kept in the dark at 15 °C and 85% relative humidity and molted to adults five (male) and ten (female) days later.

Distribution.—Known only from the type locality in the mountains of eastern Tennessee (Map 1).

Other material examined.—None.

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